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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/994,397	11/26/2001	Paul R. Besser	039153-0472 (G1177)	7858

7590

04/22/2003

Paul S. Hunter
FOLEY & LARDNER
Firststar Center
777 East Wisconsin Avenue
Milwaukee, WI 53202-5367

EXAMINER

.GUERRERO, MARIA F

ART UNIT

PAPER NUMBER

2822

DATE MAILED: 04/22/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/994,397

Applicant(s)

BESSER ET AL.

Examiner

Maria Guerrero

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 13 November 2002.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-20 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-20 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 13 November 2002 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 2,3.
- 4) ☐ Interview Summary (PTO-413) Paper No(s) _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other:

DETAILED ACTION

1. This Office Action is the First Action on the merits.

Claims 1-20 are pending.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Claims 1-7, 9-13, 15-17, and 19-20 are rejected under 35 U.S.C. 102(e) as being anticipated by Andricacos et al. (U.S. 6,268,291).

Andricacos et al. teaches forming a barrier material layer along lateral sidewalls and a bottom of a via, the via electrically connecting a first conductive layer and a second conductive layer (Fig. 2, 4B, 5B, 6, col. 8, lines 48-60, col. 10, lines 13-20, 35-40). Andricacos et al. discloses implanting a metal into the barrier material layer, the implanted metal making the barrier material layer more resistant to copper diffusion (col. 5, lines 60-65, col. 6, lines 45-67, col. 8, lines 15-20, col. 10, lines 33-40, 48-55, 60-65). Andricacos et al. shows the barrier layer being tantalum and implanting tin (Sn) (heavy metal) (col. 10, lines 52-55, 62-65).

In addition, Andricacos et al. shows the implanted metal forms an intermetallic with the second conductive layer (copper) (col. 13, lines 5-10). Andricacos et al. teaches providing a copper layer over an integrated circuit substrate, providing a barrier material layer at a bottom and sides of a via positioned over the copper layer, implanting a low dose metal species into the barrier material layer at an angle of zero degrees (Fig. 2, 4b, 6, col. 8, lines 48-65).

Furthermore, Andricacos et al. discloses depositing a copper layer, depositing an etch stop layer over the copper layer, and depositing an insulating layer over the etch stop layer (Fig. 2, col. 8, lines 30-55). Andricacos et al. teaches forming an aperture in the insulating layer and the etch stop layer, providing a barrier material at a bottom and sides of the aperture, implanting a metal species into the barrier material layer, the implanted metal making the barrier material layer more resistant to copper diffusion (Fig. 2, 4B, 6, col. 10, lines 15-20, 35-40, and 48-50). Andricacos et al. inherently shows that the implanting make the barrier material layer amorphous. Andricacos et al. shows filling the aperture with a via material to form a via and providing a conductive layer over the via such that the via electrically connects the conductive layer to the copper layer (Fig. 2, 6, col. 8, lines 35-60).

2. Claims 10 and 14 are rejected under 35 U.S.C. 102(b) as being anticipated by Kwon (U.S. 5,899,740).

3. Kwon teaches providing a copper layer (19a) over an integrated circuit substrate (1), providing a barrier material layer (25) at a bottom and sides of a via positioned over the copper layer (19a) (Fig. 6-7, col. 4, lines 19-50). Kwon shows amorphizing the

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barrier material layer in order to making the barrier material layer more resistant to copper diffusion and providing a conductive layer over the via such that the via electrically connects the conductive layer to the copper layer (Fig. 7, col. 4, lines 40-50). Kwon teaches the barrier material layer being tantalum, titanium nitride, or tungsten nitride (col. 3, lines 2-4, 57-60).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. Claims 8 and 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Andricacos et al. (U.S. 6,268,291) in view of Farrar (U.S. 6,426,289).

Regarding claims 8 and 18, Andricacos et al. does not specifically show the specific thickness and energy as claimed. However, Andricacos et al. teaches implanting at various energies ranging from a few KeV to several hundred KeV (col. 11, lines 7-10). In addition, Farrar shows forming a barrier layer having a thickness of 5 to 40 Angstroms and implanting with an energy level between 0.5 KeV to 2.0 KeV (col. 4, lines 25-38).

Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Andricacos et al. reference by specifying the

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thickness and energy as taught Farrar because it is within the capabilities of a skilled in the art.

Conclusion

5. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Jain (U.S. 5,821,168) and Rathore et al. (U.S. 6,069,068) teach forming a copper interconnection. Blish, II et al. (U.S. 5,882,738) is cited as evidenced to show that Andricacos et al. inherently shows that the implanting make the barrier material layer amorphous (Blish, II et al., col. 2, lines 50-65). Ma (U.S. 6,410,383) shows a method of forming diffusion barriers by depositing an initial film and implanting ions to modify the film.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Maria Guerrero whose telephone number is 703-305-0162.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Amir Zarabian can be reached on 703-308-4905. The fax phone numbers for the organization where this application or proceeding is assigned are 703-308-7722 for regular communications and 703-308-7724 for After Final communications.

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Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.

Maria Guerrero
Maria Guerrero
Patent examiner
April 18, 2003